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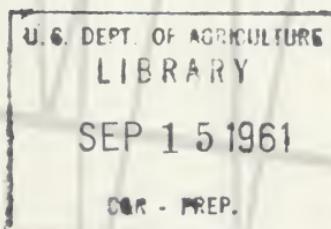
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MADISON RIVER CANYON

EARTHQUAKE

Area

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Natural attractions and the easily-seen effects of one of America's stronger earthquakes have made the Madison River Canyon of southwestern Montana one of the outstanding scenic and geological study areas in the West. To preserve some of these wonders and to make them available to the public, the Chief of the Forest Service has established the Madison River Canyon Earthquake Area. The 37,800-acre area is located on the Gallatin National Forest and is administered by the Forest Service of the U. S. Department of Agriculture. The locality was the scene of large-scale destruction and tragedy but it is of great scientific and general interest and provides a dramatic example of mountain-building and earth-shaping processes.

The Madison River Canyon Earthquake Area will be developed and managed in keeping with the long-established Forest Service principle of multiple use. While the main objectives are to preserve earthquake features and to provide for public use and safety, the area will also be managed for its other values such as wildlife, grazing, timber and water production. Facilities and roads will be improved as rapidly as possible in order to enhance public access and use.

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Over 200 vacationers were trapped in Madison Canyon when the earthquake destroyed whole sections of highway.

Escape was blocked by the slide and by scarps like this one near Hebgen Lake. Many agencies helped in rescue work.

The Quake

It was near midnight on August 17, 1959. The quiet of a soft summer night lay gently over southwestern Montana. Hundreds of vacationers were asleep in camps, trailers and lodges near Hebgen Lake and along the Madison River. At 11:37 the first heavy shock smashed through the night. Earth and rock buckled, lifted, and dropped. Boulders crashed down into canyons and valleys. Mother Earth was reshaping her mountains, not with the gentle hand of time, but in violent response to an agony of deep-seated tensions no longer bearable.



An eight-state area felt the first heavy jolt of the Hebgen Lake Earthquake. It was one of the strongest earthquakes ever recorded in the United States. That first shock was felt from the Pacific Coast eastward into western North Dakota. It was felt from Utah and Nevada northward into British Columbia. Surface damage extended from near Old Faithful Geyser in Yellowstone National Park westward for about fifty miles. The area of heaviest visible damage is near two large faults in Madison Canyon on the Gallatin National Forest. One large fault ripped the earth's surface on a fifteen-mile front from the forest's eastern boundary to a point north of Hebgen Dam. Another major fault paralleled the north shore of Hebgen Lake and old Highway 287.

On the fateful night of the earthquake, deep-seated tensions opened the two major faults, tilted the bed of Hebgen Lake, and damaged Hebgen Dam. The movement and resulting shock sent at least four surges of water plunging over Hebgen Dam. Faults shot across highways; cracks split along and across roads and trails; several large sections of Highway 287 dropped into Hebgen Lake. But that first shock was only the beginning. Major aftershocks and hundreds of tremors shook the mountains and plateaus of southwestern Montana and northwestern Wyoming during the next several weeks. Soon after the main shock, a gigantic landslide came down across the mouth of Madison Canyon. Many people were trapped.

For most of the vacationers there were hours of ordeal yet to come. For a few there was final tragedy. Nine persons were killed and another 19 are presumed buried beneath the huge slide. At dawn a plane made a reconnaissance flight; rescue units from many agencies were soon on the move. Forest Service smokejumpers parachuted into the canyon to give aid and to set up communications.

Injured were flown out by Air Force and Forest Service helicopters and others were able to leave the canyon by evening. The emergency was soon over. The earth lay nearly still amid the harsh signs of the long struggle to adjust to its realigned foundations. As earth tremors weakened, damage control work started. Army Engineers raced to cut a safe overflow through the slide before the rapidly rising new lake reached Hebgen Dam, and to avert a flood threat to towns below the Madison slide.



What to See

The Madison River Canyon Earthquake Area is a part of the Madison Range, a series of rugged mountains which are being actively uplifted. Altitudes vary from 6,200 feet to over 10,000 feet. Most of the main geologic forms left by the earthquake may be seen within the area's boundaries. Opportunities to see and enjoy the more remote features will increase as planned improvement work is completed. The most spectacular features may be seen either from present roads or by walking short distances.



Most obvious sign of the earthquake is the huge slide, above. The spillway in the center is man-made. The photo on the

left shows another feature caused by the quake. Below is a view of a submerged section of the north shore of Hebgen Lake.



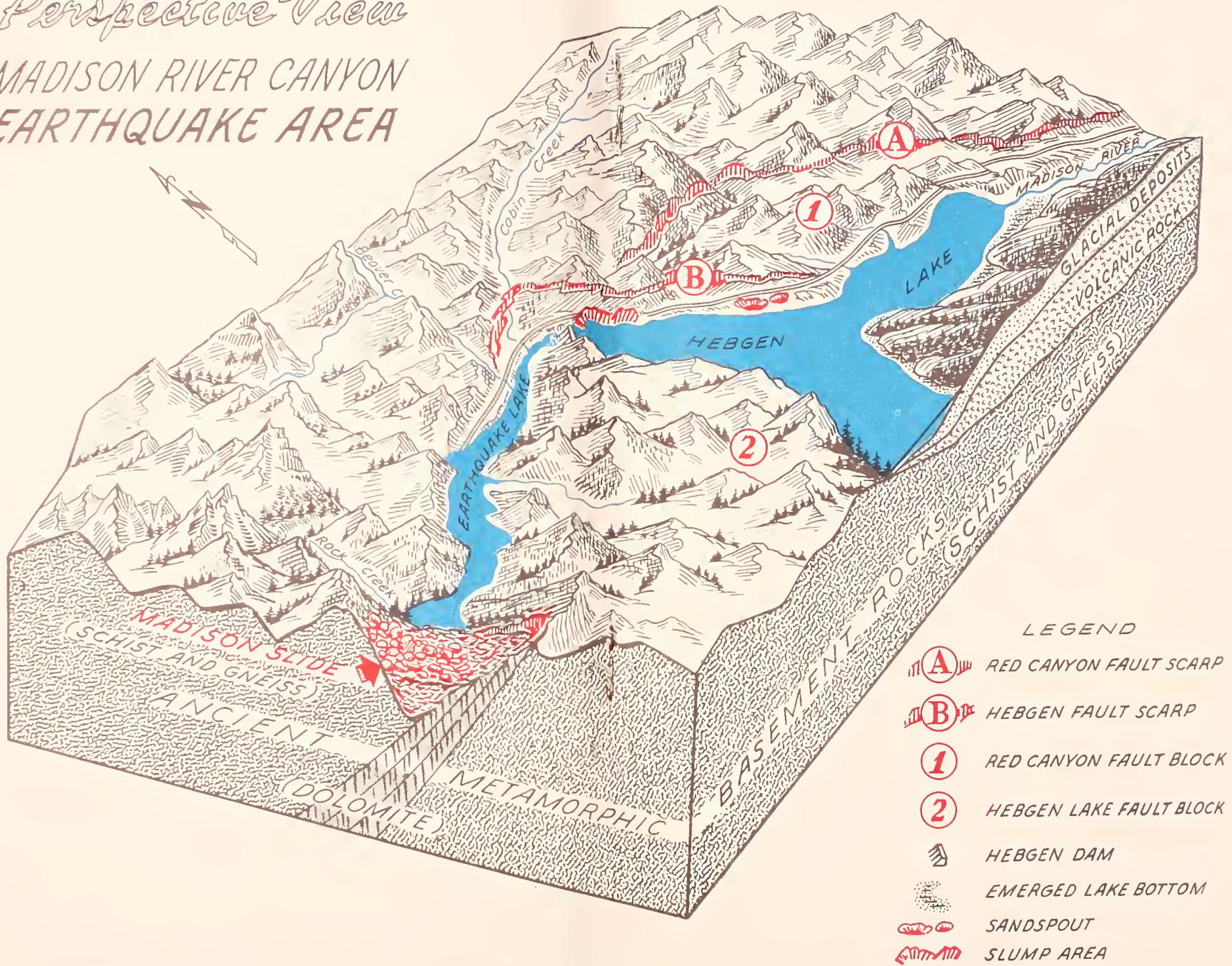
With the slide underfoot the viewer can look south up the opposite slope, then trace the course of the slide for 3,000 feet down into the canyon, across the spillway cut by the Army Engineers and on up to where he is standing. Across the spillway are trees which rode down the mountain on the surface of the slide. To the north and near the viewing point are large dolomite boulders which came from the opposite canyon wall; one of them bears a memorial marker to those whose lives were lost during the earthquake. The old highway emerges from under the slide on the west; to the east it runs for about four miles beneath the waters of Earthquake Lake.

Several obvious earthquake features can be seen in the vicinity of Hebgen Lake. The old Cabin Creek campground just northwest of the dam provides a close and dramatic view of the Hebgen fault scarp. This scarp can also be seen along the slope above the dam. Measurements show that Hebgen Dam dropped about 9 feet. Submerged trees and brush on part of the north shoreline are also signs of a drop. Several slipouts which carried sections of highway into the lake may be seen southeast of the dam. A 300-acre area which was severely torn by an earth flow is located a mile and a half up Kirkwood Creek and can be reached by a short hike. Near Dave Johnson Creek, about four miles east of the dam, is a large cavity caused by water action during the earthquake. At the end of a short drive up Red Canyon Creek, four miles west of the Duck Creek "Y", there is a good view of the Red Canyon fault scarp, the longest and most spectacular of the scarps. There are also many less spectacular features. On the south arm of Hebgen Lake is a 1,300-acre tract of dry land which was once lake bottom. Small fissures can be seen in many places. Several miles of the main fault scarps can be seen from a distance.

The area offers opportunities for general outdoor enjoyment. Campgrounds are being developed within the area as part of Operation Outdoors, and there are numerous improved campgrounds located outside the area's boundaries. Fishing is regulated by the Montana Fish and Game Department, and a Montana fishing license is required. Visitors will find helpful information and directional signs near points of interest. Safety suggestions are posted for the protection of visitors.

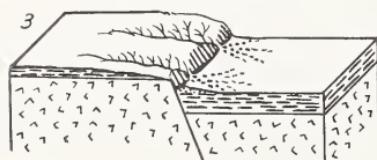
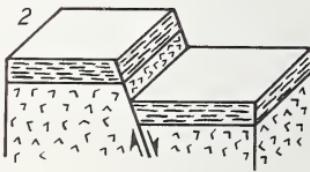
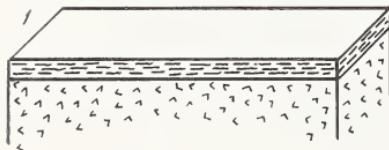


Perspective View MADISON RIVER CANYON EARTHQUAKE AREA





Earth Shaping



This Sequence Illustrates One Method by Which the Earth's Surface is Shaped by Faulting

1. Undisturbed block of the earth's crust.
2. Block broken by a fault, forming a fault scarp on surface.
3. Erosion on surface of block modifying fault scarp and forming stream gullies.



Remnants of dolomite ridges which gave way and permitted the slide to come down can be seen on the right in the

above photo. At left is Madison Canyon slide. The building in the photo below floated into this earthquake-made cove.





Nearly every feature seen on the surface of the earth owes its origin to some geologic process. Dynamic forces within the earth raise, lower, fault (fracture), and fold the crustal rocks. Erosional agents, such as water and air, wear them down. The two processes work together to form mountains and valleys.

On the night of August 17, 1959, strains and stresses building up within the earth in the vicinity of Hebgen Lake were released suddenly by fault movements. This caused the earthquake. The center, or focus, of the first and strongest shock was located approximately 20 miles below the earth's surface near the Red Canyon fault scarp in Red Canyon Creek. Some idea of the strength of the first shock can be gained by comparing its magnitude of 7.1 with that of the San Francisco quake which was 8.2.



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The huge dolomite rock above is on the apex of the slide. It was shoved from the opposite canyon wall. On the left is a

fault scarp which caused considerable property damage. Below is a scene showing damage caused by falling boulders.



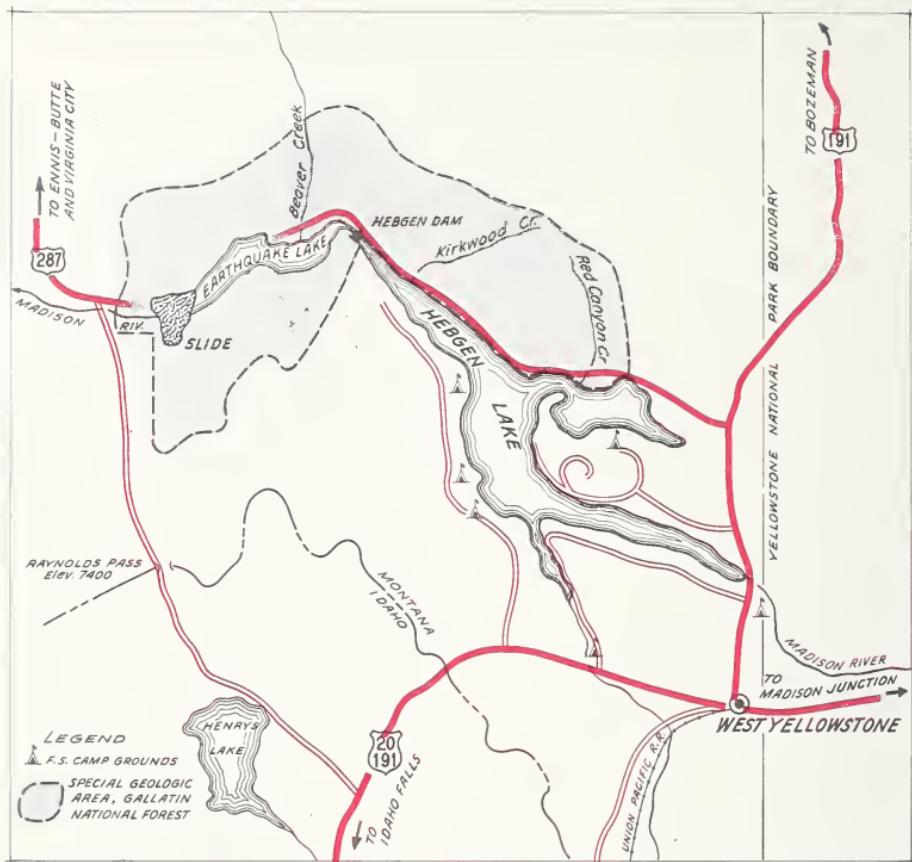
Two large blocks of the earth's crust appear to have broken and tilted toward the north. Hebgen Lake occupies part of the larger of these two fault blocks. The northernmost edge of the large block is marked by that part of the Hebgen fault scarp north of the road and along the north shore of the lake. The smaller, or Red Canyon block, lies north of Hebgen Lake. It is bounded on three sides by the arch-shaped Red Canyon fault scarp which can be traced from Kirkwood Creek along Kirkwood Ridge and then easterly across Red Canyon Creek.

The effect on the lake was much the same as if a pan of water were suddenly jostled and tilted. A huge wave sloshed back and forth across the lake for more than 11 hours. When the lake quieted, it was obvious that part of the north shore was submerged and part of the south shore raised. Near the mouth of Dave Johnson Creek, earth pressures forced underground water to the surface. The result is a large "sand spout."

One of the most awesome results of the earthquake is the huge landslide in Madison Canyon below Hebgen Dam. About 40,000,000 cubic yards of rock filled the canyon to depths of 200 to 400 feet. The bulk of the slide is composed of mica-rich metamorphic rocks (schist and gneiss) which formed the upper part of the slope before the slide occurred. These rocks were deeply weathered and very soft. They were supported by a bed of dolomite which formed the lower part of the slope. As the dolomite is much more resistant to weathering and much stronger than the mica-rich rocks, it served as a natural retaining wall to hold the softer material in place. The quake evidently caused this retaining wall to fracture, thus allowing the material on the hillside to slide into the canyon below.

Aside from its profound effect upon man and his works, this earthquake was merely a repetition of common earth-shaping events which have happened many times throughout geologic history. That such events will be repeated in various mountainous areas is little cause for alarm. Geologic events like this are keyed to geologic time--time in which man's existence is no more than a fleeting moment. Although tragic to those who lost loved ones, the Hebgen Lake earthquake has given us an opportunity to witness a dramatic display of natural forces.





Accommodations of various types are available in the vicinity of the Earthquake Area. Automobile services, cafes, motels, hotels and stores are available at several towns within a two-hour drive of the area. Commercial accommodations exist on a smaller scale at private resorts and camps in and near the area. Several small public campgrounds are located on or near the southern shores of Hebgen Lake. Other small public campgrounds are located to the west of the area. Forest Service maps show locations of these improved campgrounds. New public campgrounds are planned within the area itself. Main local access is by way of U. S. Highways 287, 20, and 191. Current highway maps and local inquiry will be helpful in planning a visit to the area.

Fences, railings and signs cannot do the whole job of protecting visitors from physical dangers or of safeguarding natural features against damage. Safety devices and signs serve as reminders of the need for caution, especially with children, in some areas.

Boating on Earthquake Lake will be permitted only after safety measures have been taken. The steep river gorge through the Madison Canyon slide is a second potential danger spot as are some of the steeper portions of the slide surface. The south canyon wall opposite the slide is considered to be dangerous. Fire poses a continual threat during the drier summer months; camp fires may be built with safety only in places provided at regular camp and picnic areas. Enjoyment of this outstanding locality will be increased by disposal of litter at collection points.

Your visit is intended to be a pleasant and memorable experience. Should you need assistance or additional information, contact Forest Service personnel in the area or at West Yellowstone.



U. S. Department of Agriculture

U. S. Forest Service

Northern Region

Missoula, Montana

Gallatin National Forest

